INTRODUCTION TO CELLULAR SYSTEM MODELLING

DEPARTMENT OF CYBERNETICS, SUMMER SEMESTER

Instructor: Daniel Georgiev
Course number: KKY/ZMB
Course textbook: The course has no one textbook but will mainly refer to *Introduction to Systems Biology* (available from Amazon.com) by Uri Alon, Weizman Institute of Science, and course notes for *Principles of Synthetic Biology* (download for free at http://qb3.berkeley.edu/synberc/courses-college.html), a joint course taught by Adam Arkin, UC Berkley, and Ron Weiss, MIT.
Course website: Selected materials will be posted on the Cell Cybernetics Lab website (http://ccy.zcu.cz/index.php/Courses)

Description/Objectives: The purpose of the course is to introduce conceptual and mathematical models required to design, simulate, and analyze biological behavior at the single cell level. Emphasis will be placed on system principles and modeling tools instead of an exhaustive biological description.

Desired course outcomes: At the end of this course, the students should be able to reason about a cell as a programmable machine. They should be able to propose simple applications and design verifiable implementations using system analysis and basic protocols from Synthetic Biology.

Grading:

Participation	25%
Design project	50%
Presentation	25%

Design project: The course will be guided by methods of Synthetic Biology, which is an engineering discipline focusing on building molecular systems using genetic programming. A large of your grade will be based on a design project. You will propose an application, design the corresponding DNA program, and simulate/analyse the resulting system. Finally, you will present your application/analysis in front of the class.

Outline (tentative):

1. Overview of Synthetic Biology
2. Biochemical reaction networks
3. Modeling and simulation with RuleBender/Matlab
4. Deterministic modeling and simulation
5. Transcriptional motifs I
6. Transcriptional motifs II
7. Stochastic modeling and simulation
8. Intracellular signaling
9. Intercellular signaling
10. Final project assignment
11. Metabolic pathways
12. Principles of robustness
13. Final project presentations